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Risø-R-Report

Radioactivity in the Risø District
January-June 2008

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Risø-R-1662(EN)

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Roskilde, Denmark
December 2008

DTU

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Title: Radioactivity in the Risø District January-June 2008
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Abstract (max. 2000 char.): The environmental surveillance of the Risø environment was continued in January - June 2008. The mean concentrations in air were: 0.45±0.39 μBq m^{-3} of ^{137}Cs, 3.9±1.6 mBq m^{-3} of ^{7}Be and 0.20±0.13 mBq m^{-3} of ^{210}Pb (±1 S.D.; N = 26). The depositions by precipitation at Risø in the first half of 2008 were: 0.064 Bq m^{-2} of ^{137}Cs, 349 Bq m^{-2} of ^{7}Be, 19.9 Bq m^{-2} of ^{210}Pb and 0.53 kBq m^{-2} of ^{3}H. The average background dose rate (TLD) at Risø (Zone I) was 64 nSv h^{-1} compared with 57±7.3 nSv h^{-1} (±1 S.D.; N = 4) in the four zones around Risø.

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Contents

Table 1. Radionuclides in ground level air collected at Risø (cf. Figs. 1, 1.1 and 1.2), January - June 2008. (Unit: μBq m^{-3})

Date	^{7}Be	^{137}Cs	^{210}Pb
02-Jan-08 – 07-Jan-08	3312	1.937	626
07-Jan-08 – 14-Jan-08	2610	0.225	54
14-Jan-08 – 21-Jan-08	2333	0.283	123
21-Jan-08 – 28-Jan-08	2838	0.314	153
28-Jan-08 – 04-Feb-08	3862	0.194	134
04-Feb-08 – 11-Feb-08	2858	0.323	160
11-Feb-08 – 18-Feb-08	4058	0.582	171
18-Feb-08 – 25-Feb-08	4217	0.265	241
25-Feb-08 – 03-Mar-08	2546	0.174	35
03-Mar-08 – 10-Mar-08	3261	0.244	84
10-Mar-08 – 17-Mar-08	2489	0.216	98
17-Mar-08 – 25-Mar-08	2453	0.245	138
25-Mar-08 – 31-Mar-08	2983	0.316	137
31-Mar-08 – 07-Apr-08	2215	0.244	124
07-Apr-08 – 14-Apr-08	3230	0.279	120
14-Apr-08 – 21-Apr-08	3801	0.645	256
21-Apr-08 – 28-Apr-08	6039	0.678	328
28-Apr-08 – 05-May-08	5620	1.249	326
05-May-08 – 13-May-08	5910	0.466	345
13-May-08 – 19-May-08	4155	0.380	199
19-May-08 – 26-May-08	5310	0.501	264
26-May-08 – 02-Jun-08	9071	0.630	346
02-Jun-08 – 09-Jun-08	5919	0.590	344
09-Jun-08 – 16-Jun-08	2293	0.341	85
16-Jun-08 – 23-Jun-08	3713	0.143	139
23-Jun-08 – 30-Jun-08	3060	0.130	124
Mean	3852	0.446	198
SD	1612	0.387	129

Table 2.1. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2008. (Unit: Bq m^{-3})

Month	^{7}Be	^{137}Cs	^{210}Pb
January	1200	0.291	87
February	1509	0.230	126
March	965	0.095	36
April	2607	0.855	164
May	2028	0.306	90
June	2083	0.426	160

Table 2.2. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2008. (Unit: Bq m^{-2})

Month	Precipitation (m)	^{7}Be	^{137}Cs	^{210}Pb
January	0.048	58	0.0140	4.2
February	0.021	31	0.0047	2.6
March	0.086	83	0.0082	3.1
April	0.017	44	0.0145	2.8
May	0.044	89	0.0134	3.9
June	0.021	44	0.0090	3.4
Sum	0.237	349	0.0639	19.9

Table 2.3. Tritium in precipitation collected at Risø (cf. Figs. 1, 2.3.1 and 2.3.2). January - June 2008. (Unit: kBq m^{-3})

Month	1 m^2 rain collector	10 m^2 rain collector
January	1.2 ± 0.2	2.1 ± 0.7
February	2.0 ± 0.1	1.6 ± 0.9
March	2.0 ± 0.6	2.6 ± 0.6
April	2.6 ± 0.4	3.0 ± 0.4
May	1.9 ± 0.2	2.6 ± 0.6
June	2.0 ± 0.4	4.4 ± 0.3

The error term is 1 S.E. of the mean of double determinations

Table 2.4. Tritium in precipitation collected at Risø (cf. Fig. 1). January – June 2008. (Unit: kBq m^{-2})

Month	Precipitation (m)	1 m^2 rain collector	10 m^2 rain collector
January	0.048	0.057	0.102
February	0.021	0.041	0.033
March	0.086	0.171	0.221
April	0.017	0.045	0.051
May	0.044	0.083	0.115
June	0.021	0.043	0.094
Sum	0.237	0.44	0.62

Table 3.1. Radionuclides in sediment samples collected at Bolund in Roskilde Fjord.(cf. Fig. 3.1) January - June 2008. (Unit: Bq kg^{-1} dry)

No samples

Table 4.1. Radionuclides in seawater collected in Roskilde Fjord (cf. Fig. 4.1) January - June 2008. (Unit: Bq m^{-3})

No samples

Table 4.2. Tritium in seawater collected in Roskilde Fjord (Risø pier) (cf. Fig. 4.2) January - June 2008.

Month	kBq m^{-3}	Salinity in $^{o}/_{oo}$
January	3.5 ± 0.9	9.4
February	2.5 ± 0.7	9.3
March	2.6 ± 0.3	11.0
April	3.2 ± 0.1	10.7
May	2.4 ± 0.3	11.5
June	3.7 ± 0.6	12.0

The error term is 1 S.E. of the mean of double determinations

*Table 5.1. Radionuclides in grass collected at Risø (near the Waste Treatment Station (cf. Fig. 1)), January - June 2008. (*Measured on bulked ash samples)*

Week no. or month	Date	K (g kg^{-1} fresh)	^{137}Cs (Bq kg^{-1} fresh)	^{137}Cs (Bq m^{-2})
1	2 January	3.6	<0.5	
2	7 January	3.4	0.5 A	0.13 A
3	14 January	4.1	<0.8	
4	21 January	2.7	<0.5	
5	28 January	2.0	<0.5	
6	4 February	3.8	<0.7	
7	11 February	3.5	<0.5	
8	18 February	5.9	<0.7	
9	25 February	4.3	<0.6	
10	3 March	4.5	<0.6	
11	10 March	3.8	<0.6	
12	17 March	5.2	0.4 B	0.18 B
13	25 March	1.6	<0.5	
14	31 Maech	6.0	<0.7	
15	7 April	4.6	<0.5	
16	14 April	5.3	<0.5	
17	21 April	6.7	<0.5	
18	28 April	6.1	<0.5	
19	5 May	4.9	<0.5	
20	13 May	5.7	<0.5	
21	19 May	6.2	<0.6	
22	26 May	4.3	<0.4	
23	2 June	5.8	<0.5	
24	9 June	6.8	<0.6	
25	16 June	3.9	<0.4	
26	23 June	5.0	<0.6	
27	30 June	5.3	<0.7	
*January		3.0	0.147	0.049
*February		4.7	0.189	0.058
*March		4.3	0.131	0.049
*April		6.0	0.032 B	0.013
*May		5.5	0.030 B	0.014
*June		6.1	0.035 A	0.013

Table 5.2. Radionuclides in Fucus vesiculosus collected at Bolund in Roskilde Fjord. January - June 2008. (Unit: Bq kg^{-1} dry)

No samples

Table 7.1. Waste water collected at Risø (cf. Fig. 1), January - June 2008.

Week number	eqv. mg KCl l^{-1}	^{137}Cs (Bq m^{-3})	^{131}I (Bq m^{-3})	^{226}Ra (Bq m^{-3})
1	64	<84	<83	240 B
2	60	<113	<119	<216
3	52	<120	<127	<223
4	60	<109	<118	470 A
5	125	<112	<114	450 A
6	289	<120	<127	<231
7	140	<116	<115	<216
8	79	<119	<122	<213
9	128	<123	<121	520 A
10	107	<125	<128	<250
11	98	<121	<126	<239
12	63	<123	<131	<255
13	71	<123	<130	<234
14	47	<121	<126	<230
15	82	<128	<134	<225
16	71	<121	<128	<246
17	69	<112	<118	<216
18	68	<113	<121	<211
19	73	<114	<124	<223
20	79	<126	<124	<220
21	80	<126	<135	700 A
22	94	<104	<109	<190
23	74	<116	<122	<218
24	82	<121	<125	780
25	76	<112	<118	<218
26	95	<125	<140	800
27	90	<114	<114	<200
Mean	89			
SE	8.8			

Table 8.1. Background dose rates around the border of Risø (cf. Fig. 8.1) measured with thermoluminescence dosimeters (TLD) in the period October 2007 – May 2008. (Results are normalized to nSv h^{-1})

Location	nSv h^{-1}
1	51
2	40
3	40
4	46
5	57
6	61
Mean	49

Table 8.2. Background dose rates around Risø (cf. Fig. 8.2 and Fig. 1) measured with thermoluminescence dosimeters (TLD) in the period October 2007 – May 2008. (Results are normalized to nSv h^{-1})

Risø zone	Location	nSv h^{-1}
I	1	44
I	2	56
I	3	105
I	4	57
I	5	57
Mean		64
II	P1	57
II	P2	42
II	P3	43
II	P4	63
Mean		51
III	P1	43
III	P2	57
III	P3	50
Mean		50
IV	P1	54
IV	P2	52
IV	P3	63
IV	P4	65
IV	P5	66
IV	P6	50
IV	P7	83
Mean		62
V	P1	69
V	P2	66
V	P3	79
V	P4	52
V	P5	69
V	P6	54
V	P7	60
V	P8	-
V	P9	60
V	P10	67
Mean		64

Table 8.3. Terrestrial dose rates at the Risø zones (cf. Fig. 8.2 and Fig. 1) January - June 2008. Measured with a NaI(Tl) detector. (Unit: nSv h^{-1})

Risø zone	Location	January	Aåril
I	1	36	36
I	2	46	47
I	3	425	404
I	4	40	41
I	5	41	39
Mean		118	113
II	P1	40	39
II	P2	40	38
II	P3	37	36
II	P4	38	38
Mean		39	38
III	P1		42
III	P2		42
III	P3		37
Mean			40
IV	P1		32
IV	P2		47
IV	P3		40
IV	P4		40
IV	P5		37
IV	P6		34
IV	P7		39
Mean			38
V	P1		36
V	P2		43
V	P3		50
V	P4		46
V	P5		44
V	P6		42
V	P7		40
V	P8		38
V	P9		36
V	P10		33
Mean			41

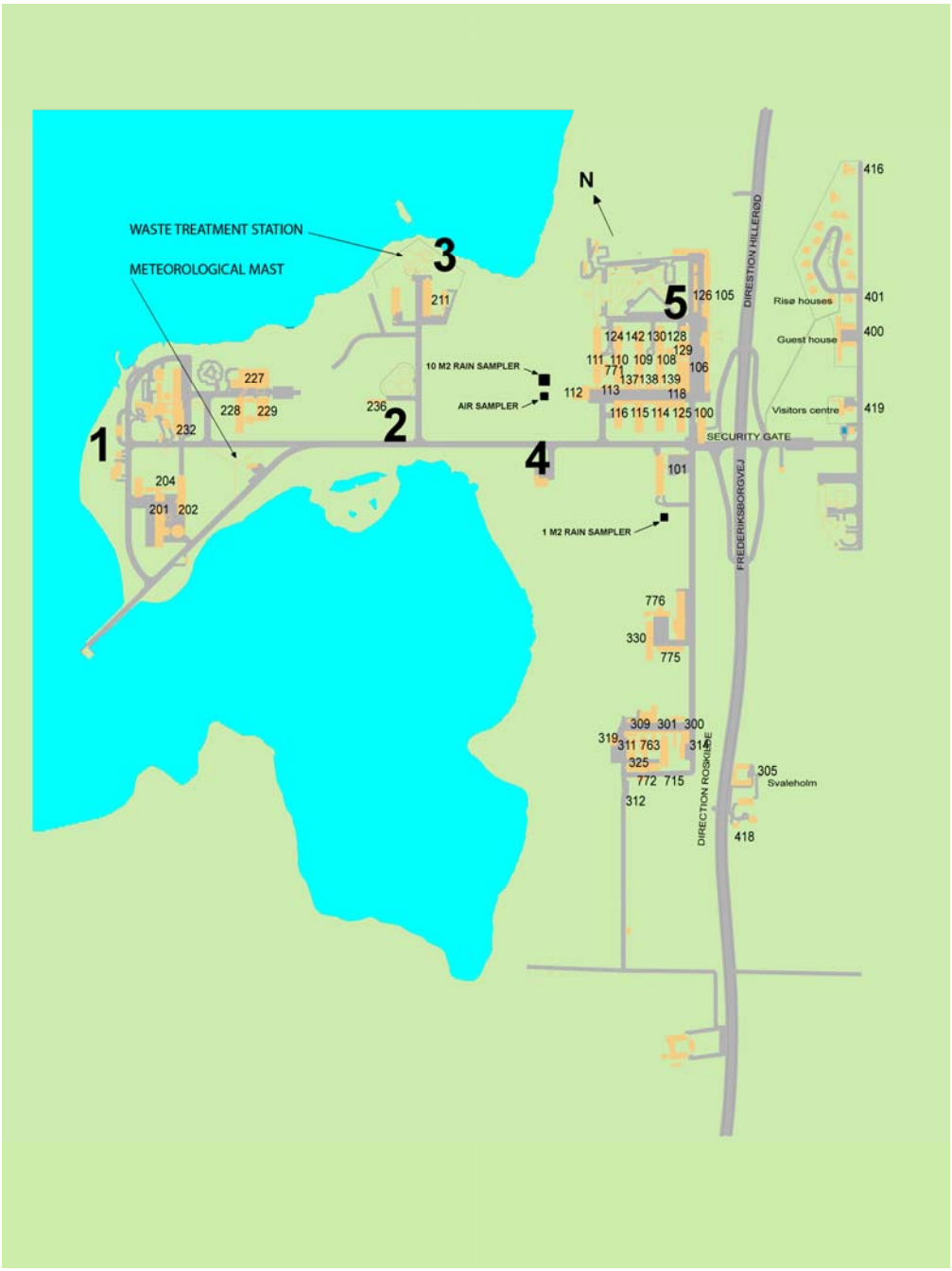


Fig. 1. Map of Risø, with building numbers.
1-5: Locations for gamma-background measurements (cf. Tables 8.2 and 8.3)

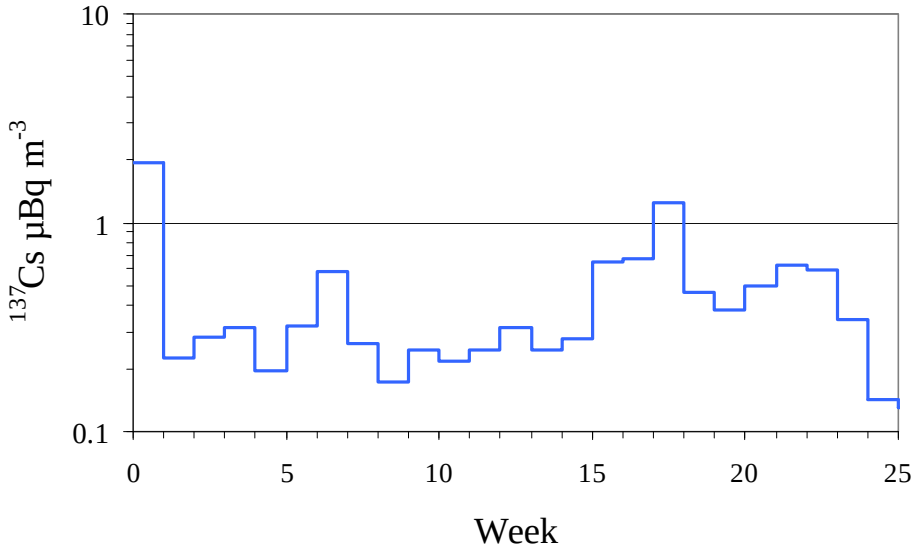
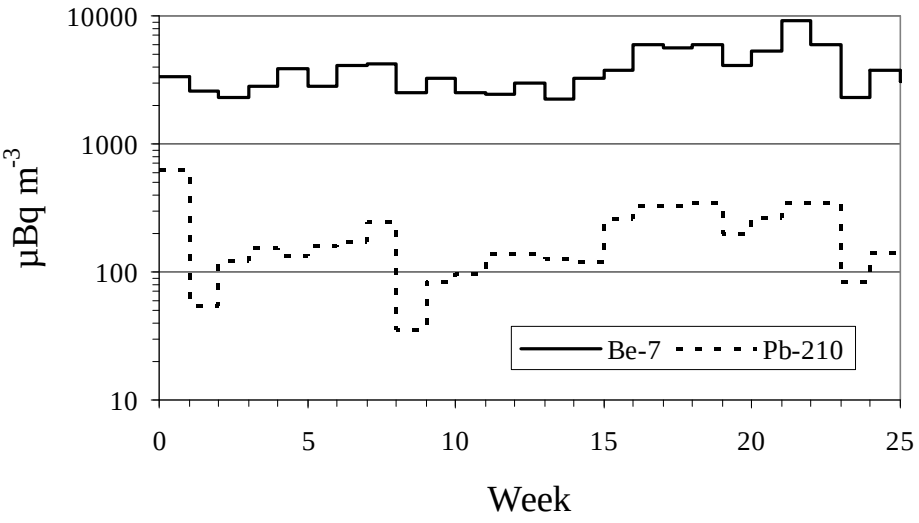


Fig. 1.1. Caesium-137 in ground level air collected at Risø in January-June 2008. (Unit: µBq m^{-3})

Fig. 1.2. Beryllium-7 and lead-210 in ground level air collected at Risø in January-June 2008. (Unit: µBq m^{-3})



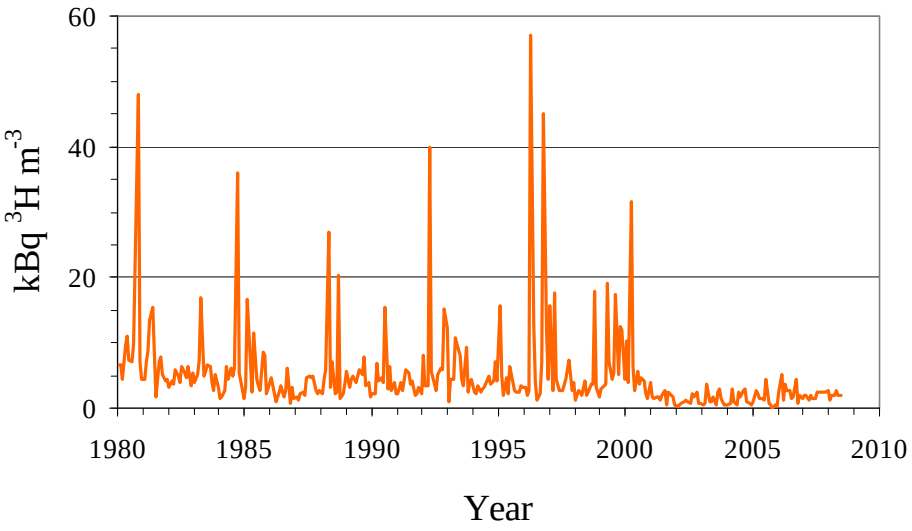
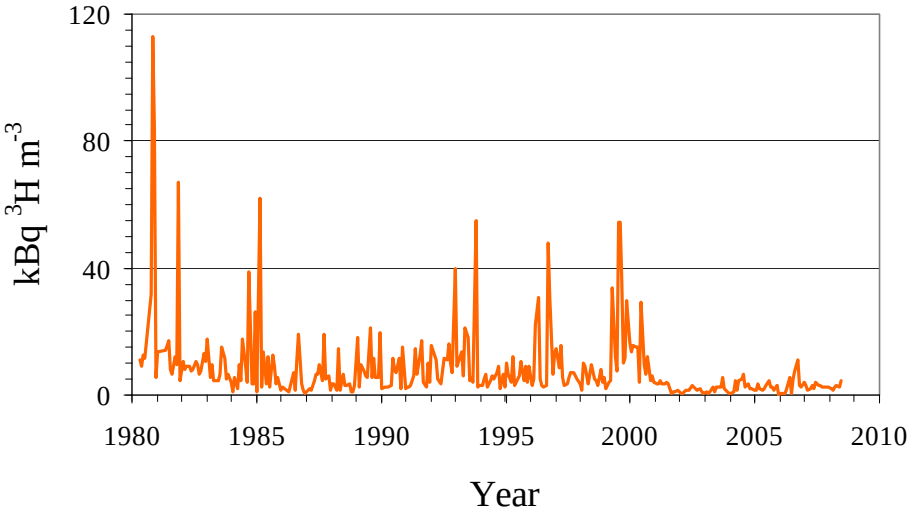


Fig. 2.3.1. Tritium in precipitation collected at Risø (1 m^2 rain collector) 1980 - 2008. (Unit: kBq m^{-3})

Fig. 2.3.2. Tritium in precipitation collected at Risø (10 m^2 rain collector) 1980 - 2008. (Unit: kBq m^{-3})



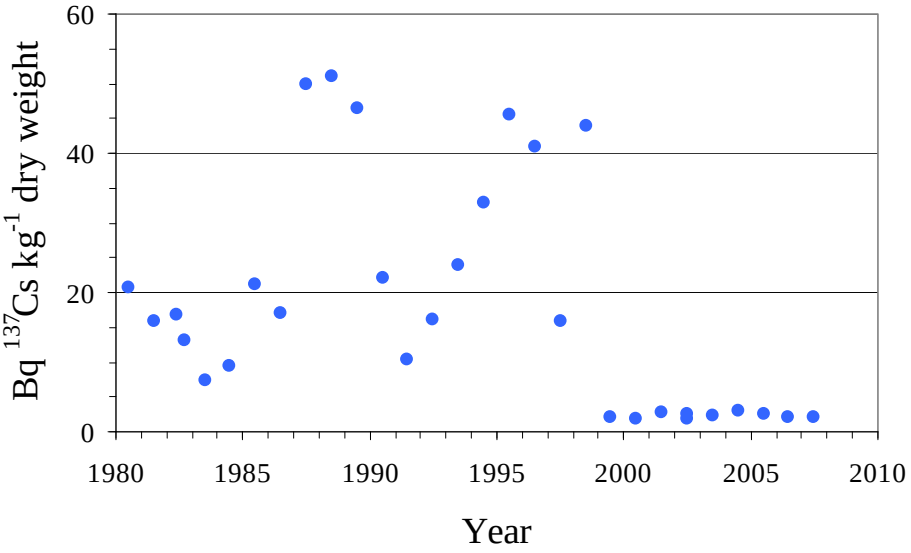


Fig. 3.1. Caesium–137 in sediment samples collected at Bolund in Roskilde Fjord. 1980 – 2008. (Unit: Bq kg^{-1} dry matter)

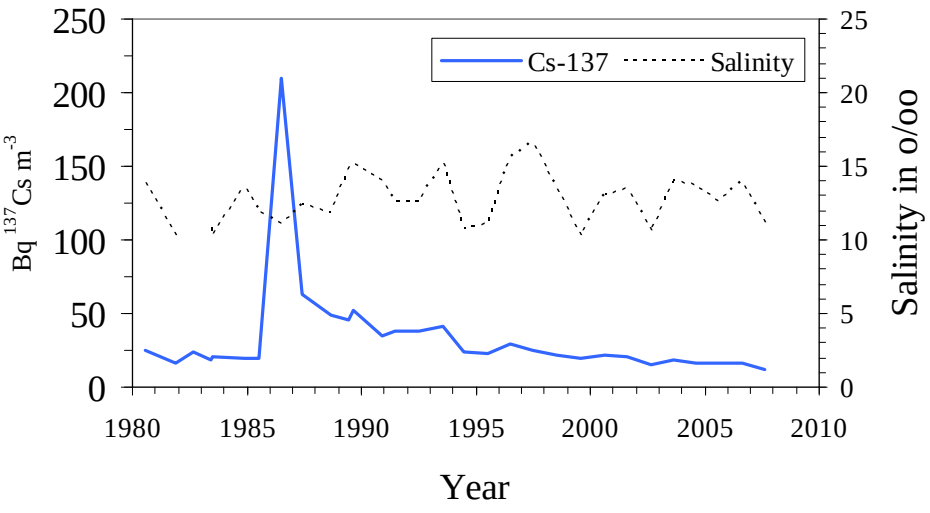
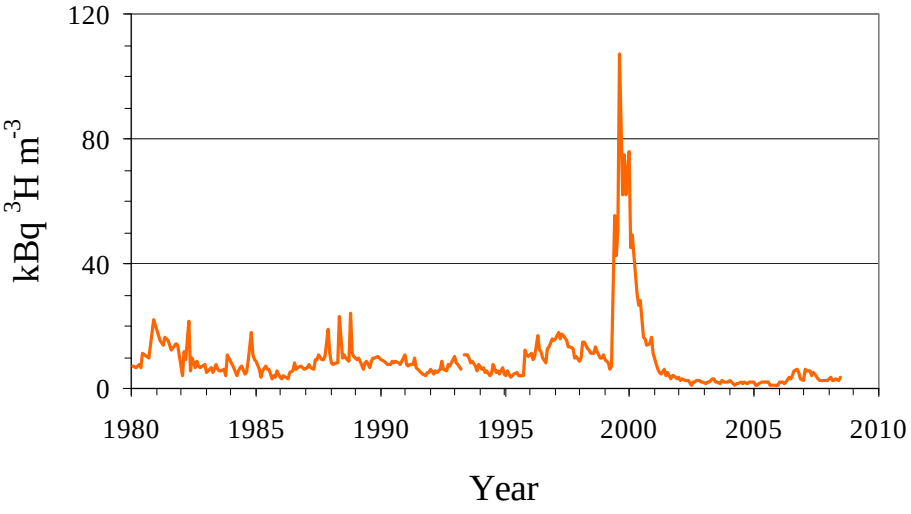


Fig. 4.1. Caesium–137 in seawater collected in Roskilde Fjord 1980 - 2008. (Unit: Bq m^{-3})

Fig. 4.2. Tritium in seawater collected in Roskilde Fjord 1980 - 2008. (Unit: kBq m^{-3})



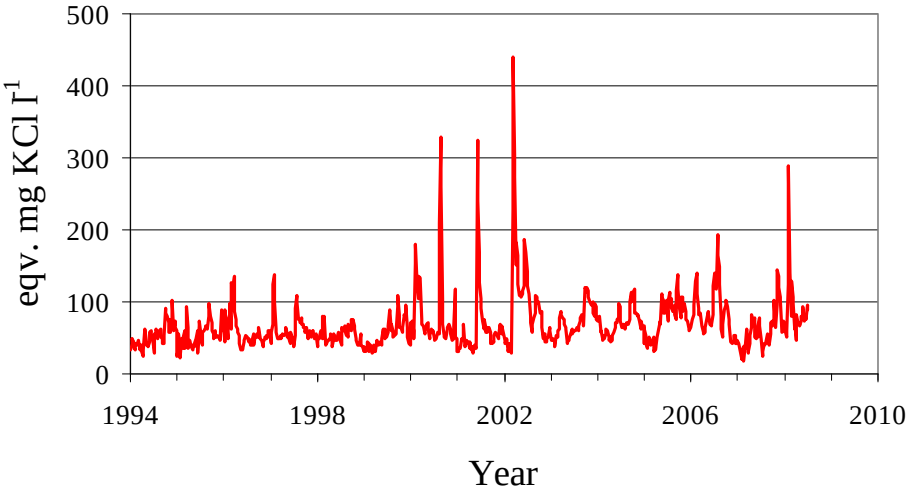


Fig. 7.1. Total-beta radioactivity in waste water collected at Risø 1994 - 2008. (Unit: eqv. mg KCl l^{-1})

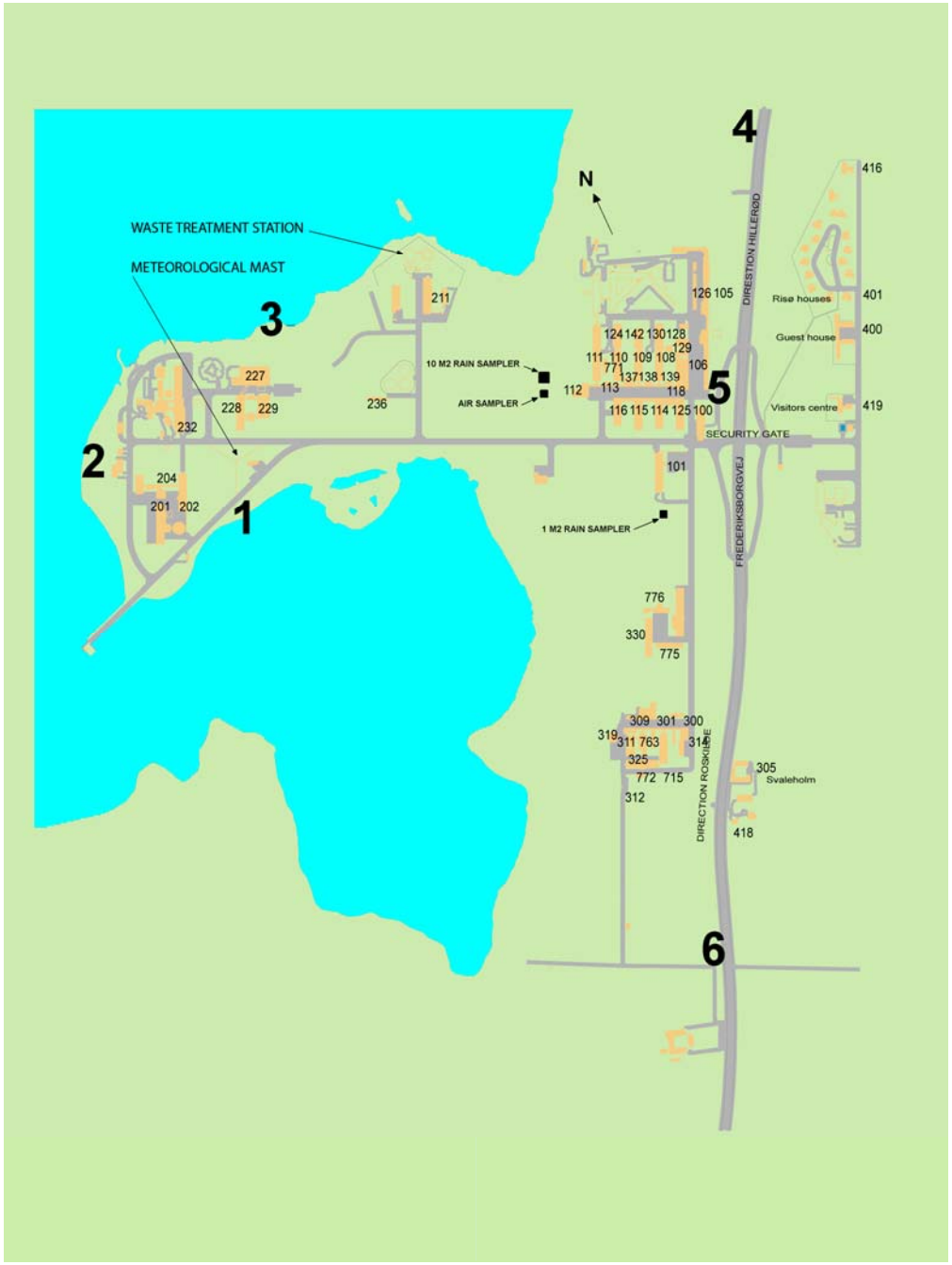


Fig. 8.1. Locations (1-6) for TLD measurements around the the border of Risø (cf. Table 8.1).

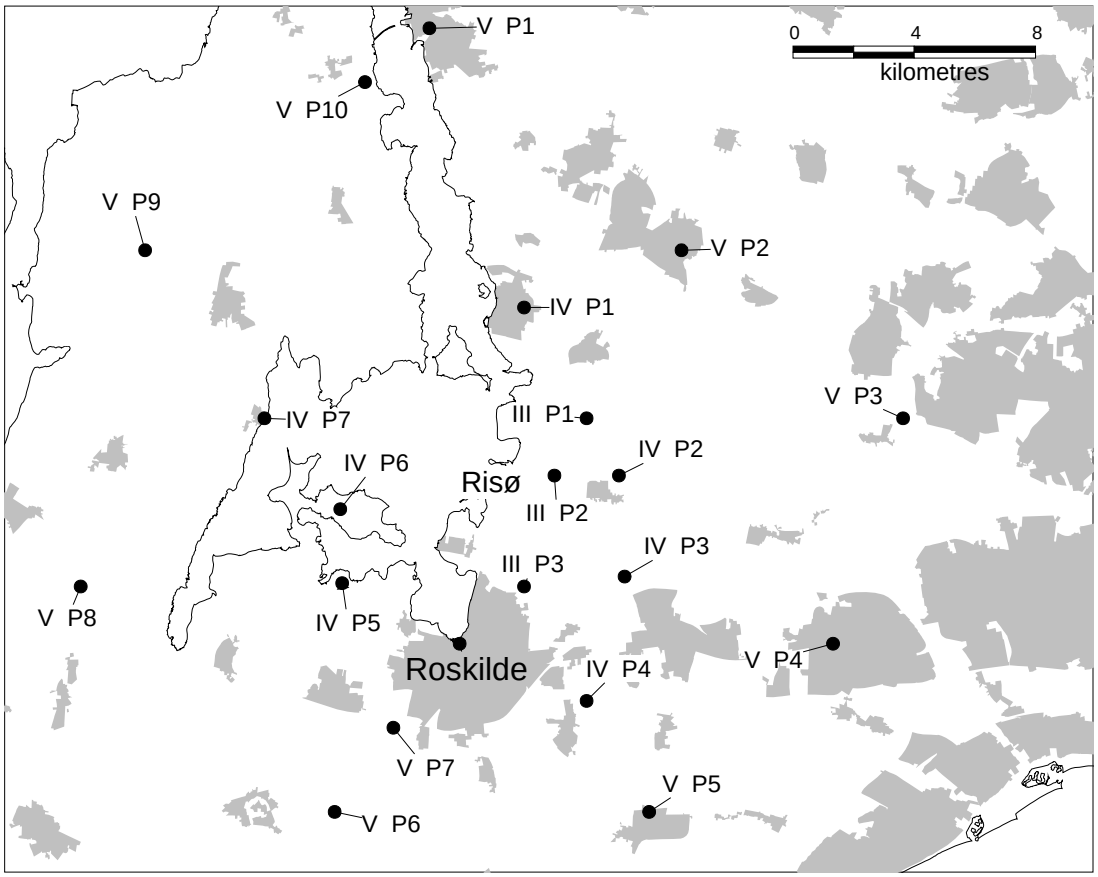


Fig. 8.2. The environment of Risø. Locations for measurements of background radiation.